

APPENDIX C

House Selection Criteria

**Exploratory Study of Basement Moisture During Operation of ASD
Radon Control Systems**

Contractor Report to EPA

December 6, 2007

The following list of house selection criteria was included in a flyer to solicit participation in the study. In addition to the prioritized list of criteria, the rationale for requiring/including are provided.

U.S. EPA/Auburn University Moisture Study

The U.S. EPA and Auburn University are conducting a 2-year field study to evaluate the use of radon mitigation techniques to control moisture entry and accumulation in basement houses. Research has linked dampness in houses with a number of debilitating health effects, including asthma. The most common and successful mitigation system, active soil depressurization, will be used in three homes to study moisture movement through basement walls and floors as the system is re-configured and cycled on/off. Measurements of environmental conditions, air pressure and flows, and house conditions will be performed in each house for the duration of the study. If this approach is successful in reducing moisture levels, it may have broad application for improving indoor air quality in many homes nationwide.

Because of the complexity in conducting accurate measurements, houses participating in this study must meet the following criteria, grouped by priority:

House Selection Criteria

Critical Criteria (participating houses must meet these criteria)

- *Owner-Occupied (or Unoccupied) Single-Family, Detached Residence* - It is important to simplify occupancy conditions and agreements/understandings with the occupants
- *Full-depth Basement Beneath the Entire House* - Basement homes have greater surface contact with the soil and tend to be influenced more by conditions in the soils and materials around the building. Full basements buried to depth of 5 to 6 feet below grade on all sides are simpler to study and understand. Foundations that also include crawlspaces, slab-on-grade, and walk-out basements are much more complicated constructions to understand and analyze. Houses with an attached garage having a slab-on-grade are acceptable.
- *Expected Residency of 18 Months* - Residents that move during the period of active monitoring and measurements may significantly disrupt data collection during this important phase of the project.
- *Evidence of Persistent Moisture Entry (Dampness) into the Basement* - Short-term variations in moisture entry can confound analysis of the effectiveness of the intervention technique. Therefore, homes that appear to have less fluctuation in moisture entry would be better candidates for this study.
- *No Liquid Water Entry or Unusual Moisture Sources* - Homes with significant liquid water entry due to leaks, major drainage problems, or very high water tables should not be selected since ASD is unlikely to be successful in these conditions. Houses where the water table is greater than 25 feet below the basement slab are preferred.
- *Unoccupied and Mostly Unfinished Basement* - The requirement for an unoccupied and minimally finished basement reduces variability in moisture response due to occupant activities and different finishes and furnishings. An unfinished basement also affords better access to basement surfaces for investigators. Basements must be able to be isolated from upper levels of the building, for example by a door.

- *Poured Basement Walls and Floor* avoid the complicated air flow pathways in blocks. At least one study house must meet this criteria. However, two houses with open core block walls will probably also be selected into the study to avoid excluding construction that may be more susceptible to moisture entry.
- *Older than Three Years of Age* - The structures should be between three and ten years of age. Homes newer than three years of age may have residual moisture from construction still stored in concrete and other materials. If this moisture is being released during the study period, moisture measurements will be affected. For more consistency in construction, homes less than ten years of age are preferred, but this is not a strict criteria for selection.
- *No Karst-like Features Affecting Basement Floors or Walls* - Solution cavities and other interconnected, below-ground voids or cavities that are in contact with the basement foundation create in-homogeneities that complicate our understanding of the surrounding soils.

Negotiable Criteria (while important and desirable, strict compliance with these criteria is not required)

- *Musty, Moldy, or Earthy Odors in the Basement* - An indicator of existing moisture problems.
- *Buildings Without an ASD Installed* are preferred, although homes with an installed passive stack could be considered. Homeowners must be willing to have an ASD system installed, or a passive system activated. They must also be willing to have the system cycled on and off for certain periods.
- *No HVAC or Ducts in Basement* - To isolate the basement air from the upstairs air, the basement should not contain HVAC equipment or ducts.
- *Gravel that Forms a Capillary Break Below the Slab Floor* - As with permeable soils, a gravel layer generally results in more uniform conditions below the floor.
- *No Sumps* - Sumps connected to an encircling drain pipe alter the movement of soil air below and around a building in complex ways.
- *Elevated Pre-mitigation Basement Radon Levels* - Basement radon levels should be greater than 4 pCi/L and less than 10 pCi/L, while upstairs levels are no more than 4 pCi/l. Radon concentrations and entry rates may be useful as an approximate indicator for soil gas (and soil gas-borne water vapor) movement into a building while ASD systems are cycled on and off. Radon levels must be sufficiently elevated to indicate changes in soil gas entry rates, yet must be low enough in occupied areas so that exposure is minimized when the ASD systems are cycled off.
- *Permeable Soils Around the Building* - Permeable native soils (e.g., glacial tills) tend to have better uniformity in radon levels surrounding the substructure and have more consistent air flow pathways.
- *Geographical Location* - To reduce climatic variability, buildings should all be located in close proximity